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Women in Development

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How Structure of Production Determines the Demand for Human Capital

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To promote gender equity, expansion of the services sector should be encouraged. But this runs counter to the World Bank and IMF policy of encouraging the production of tradable goods (produced mainly in agriculture and less so in industry) to service debt. So direct government intervention is needed to promote investment in women's human capital.

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This paper — a product of the Women in Development Division, Population and Human Resources Department — is part of a larger effort in PRE to determine if and how women's productivity (and thus family welfare) are improved when women are given more access to education, training, credit, health care, and other public resources. Copies are available free from the World Bank, 1818 H Street NW, Washington DC 20433. Please contact Audrey Sloan, room S9-121, extension 35108 (43 pages, with tables).

Explanations of lower investments in female schooling and health than in male assume that demand for these components of human capital somehow exists — and they concentrate on the supply of human capital by the household.

Gill and Khandker try to remedy the neglect of demand-side factors by examining exogenous dimensions of development. They include the structure of production — represented by the shares of agriculture, services, and industry in national employment or income — as an identifying variable for the demand for human capital.

Their reasoning is that the production functions of these three sectors differ in their requirements for skills. Industry and services require more educated workers than agriculture does — and industry requires more full-time educated workers than services does.

The authors assume that women have a comparative advantage over men in the home sector, so women spend more time at home. But industry favors males over females more than the services sector does. If the importance of industry increases at the expense of agriculture, the demand for schooling will increase for both men and women, but especially for men. Increases in the importance of services will similarly increase the demand for schooling more for women than for men.

If health is equally valued by all sectors, but health and schooling are complementary inputs to production, changes in production that encourage more schooling for men (or women) will also encourage more investments in health for men (or women).

Gill and Khandker test these propositions using primary and secondary school enrollment ratios and life expectancy levels (as proxies for investments and schooling and health) for about 90 countries in 1965 and 1987. The data for 1965 appear to be broadly supportive of the propositions; data for 1987 support them only weakly.

The empirical analysis cannot determine whether changes in the economic structure cause increases in the demand for education, or whether improved education facilitates a largely exogenous transition from an agrarian to an industrial/service economy. If issues of causality are resolved in favor of the views Gill and Khandker express in this paper, interesting policy implications emerge.

Most important, expansion of the services sector would greatly help reduce gender inequity at the same time as fostering growth.

This finding highlights the problem with relying purely on economic growth to reduce the gender gap in human capital. If income growth is accompanied by structural transformation of an economy from agrarian to industrial and then to domination by the services sector, there is no assurance that the economic status of women will improve in the early stages of this transformation.

Because the human capital of women has significant externalities — that is, because social returns to women's education and health are higher than private returns — the case is strong for direct government intervention in investments in women's human capital.

TABLE OF CONTENTS

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1. INTRODUCTION

It is well known that women are generally less schooled than men. There is also scattered evidence that people invest less in girls' health, though this is generally reflected not in lower life expectancy but in the higher incidence of illness among women. Explanations of lower investment in human capital of women assume that demand somehow exists, and focus on determinants of supply of human capital by the household.[1] We argue here that this neglect of demand side factors results in serious gaps in our understanding of the process of accumulation of human capital, and hence of economic development. We attempt to remedy this neglect by including "exogenous technological dimensions to the development process" (Schultz 1988) that differ over gender, time, and countries. Specifically, the structure of production, represented by shares of agriculture, industry and services in total employment or in gross domestic product (GDP), is included as an identifying variable for demand for human capital.

We first develop an analytical framework within which some of the determinants of differences in the human capital of males and females in developing countries can be comprehensively examined. Then, some of the implications of the theory are tested for about 90 countries in 1965 and 1987. In future work, we plan to put the implications of this and competing models

[1]See Schultz (1989) for a survey. Empirical analyses of gender differences in human capital confound the effects of (1) gender biases inherent in the utility function of parents, (2) gender differences in appropriability of returns to investments in children by their parents, and (3) gender differences in market returns to human capital.

to test using household, district, and provincial data.[2]

Following Schultz (1981), human capital can be assumed to consist of three components: health, schooling and on-the-job training. There are complementarities between these components. The most well documented, for the U.S. labor market, is that between schooling and on-the-job training. Complementarities between health and the other two components have not been empirically explored in detail. At the high levels of health observed in developed countries, investments in health do not add substantially to overall human capital. Since neoclassical labor economics until recently has been primarily directed towards developed economies, the relative neglect of health as a component of human capital reflects these low returns to incremental health. In poorer countries, given the high incidence of ill-health, increments in health substantially increase in the effectiveness of the other components of human capital. The lack of emphasis on health results in serious gaps in our understanding of the process of human capital accumulation, and hence of economic development.[3]

Just as investigating the complementarity between schooling and

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[2]See Gill (1990) for household and province level evidence on these issues for Peru in the mid-1980s.

[3]This assertion relies on the following argument: Given the relatively high "levels" of health (as reflected, for example, in life expectancy, mortality and morbidity rates) in developed countries, marginal investments in health will not substantially effect the productivity of other forms of human capital. Hence the returns to investment in schooling and on-the-job training are not strongly correlated with changes in health levels. In less developed countries, given the low health levels, marginal investments in health will substantially increase the returns to schooling and on-the-job training.

on-the-job training requires the introduction of the firm as a decision maker, a formal study of the relationship between health and returns to schooling requires the introduction of household production. A larger fraction of health is produced within the household than either schooling or job-specific skills. Understanding the determinants of investments in health necessitates the study of household production. Since women are the primary agents in household (or nonmarket) production, the role of women becomes central to the study of accumulation of human capital.

The issue of complementarity between health and schooling within the context of a household is thus a richer one than the study of this relationship at the level of an individual. Studies have documented that the health of children, as reflected in anthropometric measures such as height-by-age, weight-by-age and mortality rates, is positively correlated with the education of the parents (See Behrman 1990 for a survey). Less well documented but also significant is the finding that differences in schooling and health of sons and daughters are negatively correlated with the economic status (occupation and/or education) of women in the household.[4] This paper incorporates decisions by parents regarding both the education and health of children into a model of the household that highlights the status of women.

On this issue of women's status, the aims of this paper are: First, to make precise some of the claims and allegations made regarding the

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[4]See, for example, Rosenzweig and Schultz (1982) and Gertler and Alderman (1989) for investments in health, and Gill (1990) for investments in schooling.

existence of bias against females in the allocation of resources within the household. The idea is to formulate these questions explicitly, so that it is possible to identify whether and to what degree there is evidence of this bias. Second, to identify causes of this bias, with the objective of isolating key factors that can be used for policy.

In contrast to earlier studies that attempt to account for male-female differences in human capital, we do not assume any discrimination against females either at home (in the parents' utility function) or in the market (in the returns to human capital). All that is assumed in this paper is that women have a comparative advantage in working in some sectors of the economy. Thus increases in the shares of these sectors will increase the demand for female human capital.[5] This explicit attention to factors that can be used as policy instruments -- and the relative neglect of factors reflecting gender bias in tastes -- is the point of departure from the earlier literature such as Gertler and Alderman (1989).

The paper is organized as follows. Section 2 develops the theory. Section 3 tests these hypotheses using data from World Bank (1990), United Nations (1990), and from Summers and Heston (1988) for 1965 and 1985-87. Section 4 concludes the paper with a discussion of the policy implications.

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[5]Differences in marginal effects of sector shares on investments in schooling and health are also indicative of segmentation of the market for labor. For example, if an increase of one percent in the share of services (at the expense of agriculture) raises the demand for schooling by more than a one percent increase in the share of industry (again at the expense of agriculture), then labor market segmentation cannot be ruled out.

2. ANALYTICAL FRAMEWORK

A complete theoretical treatment of gender differences in human capital would incorporate all three forms referred to above: health, schooling and job-specific training. This paper explicitly incorporates only investments in health and schooling. This is done because of two reasons: First, an effective treatment of on-the-job training requires a multiperiod model; and second, labor market studies for developed countries have already documented the complementarities between schooling and job training. The focus here is on complementarities between components of human capital accumulated at the level of the household, i.e., health and schooling. Because of these two reasons, investment in job-specific human capital is almost completely ignored.

The Basic Structure

A representative household consisting of an adult couple, one female child and one male child (indexed by subscript $j = f, m$ respectively) is the unit of study. Fertility is therefore exogenous. Parents value only their own consumption and the welfare of their children as adults, which is assumed to depend upon each child's income. The parents' utility function is

$$U = U(C, R_m, R_f; Z) . \tag{1}$$

where C is the quantity of a general consumption good, and R_m and R_f are the "full" or potential incomes of the male and female child respectively when they are adults, and Z represents household characteristics (tastes, education, location, etc.) that affect the utility obtained by consuming C, R_m, and R_f.

Assume for the sake of simplicity that the utility function has a

Cobb-Douglas form

$$U = Z.R_m^{\beta}.R_f^{\gamma}.C^{\delta} \tag{2}$$

Full income depends upon human capital. Assume that human capital has two observable components: health and schooling. The returns to human capital functions are:

$$R_m = R_m(S_m, H_m) \tag{3a}$$

$$R_f = R_f(S_f, H_f) \tag{3b}$$

where S and H represent schooling and health capital respectively.

The budget constraint of the household is:

$$Y = C + P_S(S_f + S_m) + P_H(H_f + H_m) \tag{4}$$

where Y is the exogenously decided income of the household, P_S and P_H represent the price of schooling and health respectively, and the price of the consumption good has been normalized to equal 1.

There are two major sectors of employment: home and market. The returns to human capital are sector-specific. Overall returns to schooling depend on the time allotted to household and to market (nonhousehold) activities. The market sector is divided into three subsectors: agriculture, services, and industry. Sectors are identified as follows:

0 = household activities
1 = agriculture
2 = industry
3 = services.

Assume a Cobb-Douglas form for human capital earnings functions:

$$R_m = S_m^{(\Sigma\alpha_{mi}t_{mi})} H_m^{(\Sigma a_{mi}t_{mi})} \tag{5a}$$

$$R_f = S_f^{(\Sigma\alpha_{fi}t_{fi})} H_f^{(\Sigma a_{fi}t_{fi})} \tag{5b}$$

where t_{mi} and t_{fi} is the fraction of time devoted to activity i by female and male children respectively *when they are adults*, and

$$\sum_{i=0}^{3} t_{mi} = T_m \tag{6a}$$

$$\sum_{i=0}^{3} t_{fi} = T_f \tag{6b}$$

In the simplest case, T, the total working life of a person, is assumed to be the same for males and females, i.e. $T_m = T_f = T$, and T can be normalized to equal 1.

The earnings functions display the following properties:

(i) The marginal returns to schooling and health are decreasing functions of the level of schooling and health respectively, i.e., $\partial R_j/\partial S_j > 0$, $\partial R_j/\partial H_j > 0$, and $\partial^2 R_j/\partial S_j^2 < 0$, $\partial^2 R_j/\partial H_j^2 < 0$, $j = m,f$.

(ii) Schooling and health are complements in the earnings function, i.e., $\partial^2 R_j/\partial S_j \partial H_j > 0$, $j = m,f$.

It is important to remember that t_{mi} and t_{fi} are not chosen by the parents. These are time allocation decisions of the children when they become adults. The choice variables in the current framework are S_m, S_f, H_m, H_f, and C. Parents may *impute* the values of t_{mi} and t_{fi} on the basis of their own experiences and expectations of market conditions in the future when their children will work. There is, however, a self-fulfilling nature of this decision. If parents choose the schooling levels of the girl and the boy under the assumption of a set of t_{mi} and t_{fi}, then, if they are correct about the returns to schooling in each sector, children cannot do better than allocate their time exactly as their parents expected or intended them to.

The following assumptions are made:

(i) $t_{f0} \geq \bar{t}_0$,

(ii) $a_0 = a_1 = a_2 = a_3 = a$, for both $j = m,f$.

First, everybody gets married and has children, and women must spend more time at home than men. This could be because bearing and rearing children requires more women's time. Thus $\bar{t}_0$ could be the time required to bear and rear two children, since in our framework each household has one boy and one girl.[6] Even if there is no other difference between men and women, small differences in the productivity of males in child rearing compared to that of females can lead to large differences, even complete specialization, in work allocation patterns. (See, for example, Becker 1985). Alternatively, it can be explained as a cultural or institutional constraint. In either case, because of the time constraint (6), this implies that women generally have less time to spend in market activities.

The argument that women must spend more time at home because of their comparative advantage in childbearing and rearing raises the issue of endogeneity of fertility, since women may *choose* not to marry or have children. In that case, from the viewpoint of this theory, the difference between men and women disappears. Incorporating fertility decisions by

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[6]Changes in fertility would therefore change $\bar{t}_0$.

determining family size within the model will change some of the results derived below.

The second assumption is that return coefficients for health are the same across sectors. That is, health is equally necessary at home and in the market for effective completion of tasks. This can be tested very crudely by quantifying the extent to which ill-health prevents normal work activity in the market compared to activity at home.[7] This assumption allows us to write equations (5a) and (5b) as follows:

$$R_m = S_m^{(\Sigma\alpha_{mi} t_{mi})} H_m^{a} \tag{7a}$$

$$R_f = S_f^{(\Sigma\alpha_{fi} t_{fi})} H_f^{a} \tag{7b}$$

since $a_0 = a_1 = a_2 = a_3 = a$.[8]

On the basis of stylized facts, it is assumed that the returns to

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[7]The returns to sector-specific work experience are difficult to measure, again because of the lack of "earnings" data in the home sector. Analogous to the argument for schooling, higher technical change rates in the market may result in the returns to accumulated work experience being lower (due to obsolescence of previously learned skills) in the market than in household production. There is an important qualification: Technical change may require *continuity* of participation, so that work experience needs to be augmented by a measure of uninterruptedness of work participation.

[8]The private economic rate of return to schooling (according to the Mincerian approach) is thus

$$\frac{1}{R_j}\cdot\frac{\partial R_j}{\partial S_j} = \frac{1}{S_j}\cdot\sum_{i=0}^{3}\alpha_{ji}t_{ji}, \quad \text{for } j = m, f,$$

which is not a constant, but depends on the level of schooling S_j and sectoral time shares t_{ji}.

schooling are high in industry and services and low in agriculture. However, these may or may not differ by the sex of the workers: That is, there may or may not be sex discrimination in the market.[9] Since the return coefficient of schooling at home, α_0, is not easily or directly observed, nothing is assumed about the magnitude of α_0 relative to α_1, α_2, and α_3. It is likely that returns to schooling at home and in the market are the same at low (primary) levels, and begin to diverge at higher levels of education (secondary and postsecondary). It is difficult to test this proposition. One way is to relate characteristics of sectors with the demand for education. Schultz (1975) suggested that education may be related to the ability to deal with job disequilibria. A well documented finding in this context is the complementarity between technical change and education. Education may facilitate the implementation of new technology. (See, for example, Welch 1970 and Gill 1989). Then, if measures of technical change are available for the market sector and the home sector, we may be able to *infer* relative rates of return to schooling in the two sectors.[10]

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[9]When it is assumed that these coefficients are the same for men and women, the point is not that there is *in fact* no discrimination against women. The rationale for this assumption is simply that discrimination (either at home or in the market) is a very difficult concept to quantify. Since the goal of this paper is to derive testable implications, we abstract from assertions that are unverifiable either in principle or in practice.

[10]The assertion that a decrease in labor market discrimination against women results in an increase in schooling levels of women assumes that returns to schooling are higher in the market than at home. As pointed out earlier, this assumption is not directly verifiable. However, the assertion that an increase in the returns to schooling in jobs where men have an "intrinsic" comparative advantage (for instance, mining) increases male-female schooling differentials is, within the above framework, not dependent upon any assumption regarding human capital earnings functions. It is claims like the

First-Order Conditions for Maximization

Parents maximize their (one-period) utility function given in equation (2) subject to the budget constraint (4). The first order conditions for maximization are :

$$Z.C^{\delta}.R_f^{\gamma}.\beta.R_m^{\beta-1}.\sum_{i=0}^{3}\alpha_{mi}t_{mi}S_m^{(\Sigma\alpha_{mi}t_{mi}-1)}.H_m^{a} - \lambda P_S = 0 \qquad (8a)$$

$$Z.C^{\delta}.R_m^{\beta}.\gamma.R_f^{\gamma-1}.\sum_{i=0}^{3}\alpha_{fi}t_{fi}S_f^{(\Sigma\alpha_{fi}t_{fi}-1)}.H_f^{a} - \lambda P_S = 0 \qquad (8b)$$

$$Z.C^{\delta}.R_f^{\gamma}.\beta.R_m^{\beta-1}.S_m^{(\Sigma\alpha_{mi}t_{mi})}a.H_m^{a-1} - \lambda P_H = 0 \qquad (8c)$$

$$Z.C^{\delta}.R_m^{\beta}.\gamma.R_f^{\gamma-1}.S_f^{(\Sigma\alpha_{fi}t_{fi})}a.H_f^{a-1} - \lambda P_H = 0 \qquad (8d)$$

$$Z.R_f^{\gamma}.R_m^{\beta}.\delta.C^{\delta-1} - \lambda = 0 \qquad (8e)$$

$$Y - C - P_S(S_m + S_f) - P_H(H_m + H_f) = 0 \qquad (8f)$$

It is assumed that the second-order conditions for maximization are satisfied. That is, the utility function and returns to human capital functions have the requisite curvature. Using the first four optimality conditions, we obtain

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above that this paper seeks to make precise.

$$\frac{R_f.\sum_{i=0}^{3}\alpha_{mi}t_{mi}S_m^{(\Sigma\alpha_{mi}t_{mi}-1)}.H_m^a}{R_m.\sum_{i=0}^{3}\alpha_{fi}t_{fi}S_f^{(\Sigma\alpha_{fi}t_{fi}-1)}.H_f^a} = \gamma/\beta, \quad \text{and} \quad \frac{R_f.S_m^{(\Sigma\alpha_{mi}t_{mi})}H_m^{a-1}}{R_m.S_f^{(\Sigma\alpha_{fi}t_{fi})}H_f^{a-1}} = \gamma/\beta,$$

Simple manipulation yields

$$\frac{\sum_{i=0}^{3}\alpha_{mi}t_{mi}.H_m^*}{\sum_{i=0}^{3}\alpha_{fi}t_{fi}.H_f^*} = \frac{S_m^*}{S_f^*},$$ where asterisks denote optimized values.

This equality tells us that the male-female schooling ratio is in general not equal to the male-female health ratio. If the time-weighted return to schooling is greater (smaller) for males, then the male-female health ratio will be smaller (greater) than the male-female schooling ratio. That is, if

$$\sum_{i=0}^{3}\alpha_{mi}t_{mi} > (<) \sum_{i=0}^{3}\alpha_{fi}t_{fi}, \text{ then } H_m^*/H_f^* < (>) S_m^*/S_f^*.$$

We can solve for the demand functions for S_m, S_f, H_m, H_f and C. Schooling and health demand functions will be

$$S_m^* = \frac{\beta.\Sigma\alpha_{mi}t_{mi}}{\delta P_S}.K \tag{9a}$$

$$S_f^* = \frac{\gamma.\Sigma\alpha_{fi}t_{fi}}{\delta P_S}.K \tag{9b}$$

$$H_m^* = \frac{\beta.a}{\delta P_H}.K \tag{9c}$$

$$H_f^* = \frac{\gamma.a}{\delta P_H}.K \tag{9d}$$

where $K = \dfrac{Y.\delta}{\delta - \beta(a + \Sigma\alpha_{mi}t_{mi}) - \gamma(a + \Sigma\alpha_{fi}t_{fi})}$

is normalized income.

Note here that δ represents the response elasticity in utility with respect to consumption C, $\beta(a + \Sigma\alpha_{mi}t_{mi})$ measures the response elasticity of utility with respect to investment in male children (in terms of schooling and health) and $\gamma(a + \Sigma\alpha_{fi}t_{fi})$ measures the response elasticity of utility with respect to investment in female children. If parents value their own consumption C more (less) than investment in their offspring, then δ is greater (smaller) than $[\beta(a + \Sigma\alpha_{mi}t_{mi}) + \gamma(a + \Sigma\alpha_{fi}t_{fi})]$.

Comparative Statics

Comparative statics with respect to the prices P_S and P_H yield:

$$\frac{\partial S_m^*}{\partial P_S} = - \frac{\beta.\Sigma\alpha_{mi}t_{mi}}{\delta.P_S^2} . \frac{Y.\delta}{[\delta - \beta(a + \Sigma\alpha_{mi}t_{mi}) - \gamma(a + \Sigma\alpha_{fi}t_{fi})]} \tag{10a}$$

$$\frac{\partial S_m^*}{\partial P_S} = - \frac{\gamma.\Sigma\alpha_{fi}t_{fi}}{\delta.P_S^2} . \frac{Y.\delta}{[\delta - \beta(a + \Sigma\alpha_{mi}t_{mi}) - \gamma(a + \Sigma\alpha_{fi}t_{fi})]} \tag{10b}$$

$$\frac{\partial H_m^*}{\partial P_H} = - \frac{\beta.a}{\delta.P_H^2} . \frac{Y.\delta}{[\delta - \beta(a + \Sigma\alpha_{mi}t_{mi}) - \gamma(a + \Sigma\alpha_{fi}t_{fi})]} \tag{10c}$$

$$\frac{\partial H_f^*}{\partial P_H} = - \frac{\gamma.a}{\delta.P_H^2} . \frac{Y.\delta}{[\delta - \beta(a + \Sigma\alpha_{mi}t_{mi}) - \gamma(a + \Sigma\alpha_{fi}t_{fi})]} \tag{10d}$$

If standard consumer theory applies, then the own-price effect must be negative. This implies that

$$\delta > [\beta(a + \Sigma\alpha_{mi}t_{mi}) + \gamma(a + \Sigma\alpha_{fi}t_{fi})],$$

i.e., parents value consumption more than investment in their offspring. This does not, however, mean that parents must invest equally in male and female children. If parents value their son's human capital more than their daughter's, then the demand for education and health of boys will be less own-price elastic than that for girls. This would mean that

$$\left|\frac{P_S}{S_m}\cdot\frac{\partial S_m}{\partial P_S}\right| < \left|\frac{P_S}{S_f}\cdot\frac{\partial S_f}{\partial P_S}\right| \quad \text{and}$$

$$\left|\frac{P_H}{H_m}\cdot\frac{\partial H_m}{\partial P_H}\right| < \left|\frac{P_H}{H_f}\cdot\frac{\partial H_f}{\partial P_H}\right|.$$

However, computing these own-price elasticities with the functional forms assumed above yields

$$\frac{P_S}{S_m}\cdot\frac{\partial S_m^*}{\partial P_S} = \frac{P_S}{S_f}\cdot\frac{\partial S_f^*}{\partial P_S} = -1, \text{ and}$$

$$\frac{P_H}{H_m}\cdot\frac{\partial H_m^*}{\partial P_H} = \frac{P_H}{H_f}\cdot\frac{\partial H_f^*}{\partial P_H} = -1.$$

That is, the demand for education and health are equally price elastic for boys and for girls.[11] Given the homothetic preference structure and return functions, parental investment in male and female children are equally price elastic. No gender bias exists as long as preferences are homothetic.

[11]The cross-price elasticities all equal 0:

$$\frac{P_S}{H_m}\cdot\frac{\partial H_m^*}{\partial P_S} = \frac{P_S}{H_f}\cdot\frac{\partial H_f^*}{\partial P_S} = \frac{P_H}{S_m}\cdot\frac{\partial S_m^*}{\partial P_H} = \frac{P_H}{S_f}\cdot\frac{\partial S_f^*}{\partial P_H} = 0.$$

Again, if parents value sons more than daughters, then the demand for girls' human capital (schooling and health) will be more income elastic than that for boys. But in the framework above,

$$\frac{Y}{S_m}\cdot\frac{\partial S_m^*}{\partial Y} = \frac{Y}{S_f}\cdot\frac{\partial S_f^*}{\partial Y} = 1, \text{ and}$$

$$\frac{Y}{H_m}\cdot\frac{\partial H_m^*}{\partial Y} = \frac{Y}{H_f}\cdot\frac{\partial H_f^*}{\partial Y} = 1.$$

Again, no gender bias is revealed for investments in children's human capital.

Comparative statics with respect to sector shares in time allocation (t_i) yield:

$$\frac{\partial S_m^*}{\partial t_{mi}} = \frac{\beta\alpha_{mi}Y}{\delta P_S}\cdot\frac{\beta\Sigma\alpha_{mi}t_{mi} + [\delta - \beta(a + \Sigma\alpha_{mi}t_{mi}) - \gamma(a + \Sigma\alpha_{fi}t_{fi})]}{[\delta - \beta(a + \Sigma\alpha_{mi}t_{mi}) - \gamma(a + \Sigma\alpha_{fi}t_{fi})]^2} \tag{10e}$$

$$\frac{\partial S_f^*}{\partial t_{fi}} = \frac{\gamma\alpha_{fi}Y}{\delta P_S}\cdot\frac{\gamma\Sigma\alpha_{fi}t_{fi} + [\delta - \beta(a + \Sigma\alpha_{mi}t_{mi}) - \gamma(a + \Sigma\alpha_{fi}t_{fi})]}{[\delta - \beta(a + \Sigma\alpha_{mi}t_{mi}) - \gamma(a + \Sigma\alpha_{fi}t_{fi})]^2} \tag{10f}$$

$$\frac{\partial H_m^*}{\partial t_{mi}} = \frac{\beta aY}{\delta P_H}\cdot\frac{\beta\alpha_{mi}}{[\delta - \beta(a + \Sigma\alpha_{mi}t_{mi}) - \gamma(a + \Sigma\alpha_{fi}t_{fi})]^2} \tag{10g}$$

$$\frac{\partial H_f^*}{\partial t_{fi}} = \frac{\gamma aY}{\delta P_H}\cdot\frac{\gamma\alpha_{fi}}{[\delta - \beta(a + \Sigma\alpha_{mi}t_{mi}) - \gamma(a + \Sigma\alpha_{fi}t_{fi})]^2} \tag{10h}$$

For a rise in time allocation to an activity i, *holding constant the time allocations to other sectors*, to raise the demand for schooling and health, $\partial S_j^*/\partial t_{ji} > 0$ and $\partial H_j^*/\partial t_{ji} > 0$, respectively for i= 1,2,3; j =m,f. The condition that parents value their own consumption more than investment in their offsprings' human capital, i.e.,

$$\delta - \beta(a + \Sigma\alpha_{mi}t_{mi}) - \gamma(a + \Sigma\alpha_{fi}t_{fi}) > 0,$$

is sufficient but not necessary to assure this. Thus an increase in expected working life (due to, say, an increase in longevity[12]) will always raise the investment in schooling and health.

The more interesting case arises if the increase in t_i is at the expense of time allocated to some other sector. The results above suggest that the implications for investment in schooling *and* health would depend only on the relative values of the schooling coefficient α in the two sectors. Thus if the schooling coefficient is larger in the sector whose share in time has increased than in the sector whose share has decreased, this would increase both investment in schooling and health.

Differences in these coefficients across sexes may exist:
$\partial S^*_m/\partial t_{mi} \gtrless \partial S^*_f/\partial t_{fi}$ according as $\beta^2\alpha_{mi}.\Sigma_i\alpha_{mi}t_{mi} \gtrless \gamma^2\alpha_{fi}.\Sigma_i\alpha_{fi}t_{fi}$, and
$\partial H^*_m/\partial t_{mi} \gtrless \partial H^*_f/\partial t_{fi}$ according as $\beta^2\alpha_{mi} \gtrless \gamma^2\alpha_{fi}$.

If women work more at home (sector 0), and if α_0 is smaller than (or is perceived to be smaller than) α_1, α_2, and α_3, then parents will invest less in the schooling of girls than of boys, even if there is no discrimination against female offspring either at home (i.e., $\beta = \gamma$) or in the labor market (i.e., $\alpha_{mi} = \alpha_{fi}$, for all i). However, under the functional forms assumed above, investments in health will be the same for boys and girls.

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[12]The next subsection examines this in greater detail.

Introducing Gender Differences

The following issues are taken up in turn in this section:

(1) So far, we have assumed that the demand for human capital in each of the three market sectors is equally gender-intensive. Thus if an education intensive sector (say, industry) increases in importance, this raises the demand for schooling of boys and girls equally. The framework is now extended to allow for systematic differences across sex to such shifts in the demand curve for schooling.

(2) We have ignored a crucial difference between the effects of investment in schooling and those of investment in health. While investment in schooling increases the potential or "full" earnings of a worker in any period -- *the quality of life* -- investing in health results both in an increase in the quality of life as well as adding to the number of periods that a person is likely to live -- *the quantity of life* (See Ehrlich and Chuma 1990).

(1) Differences Between Industry and Services

The only distinction between men and women is that, in general

$$\sum_{i=1}^{3} t_{fi} < \sum_{i=1}^{3} t_{mi} , \qquad (12)$$

since $t_{f0} > t_{m0}$; women must spend more time at home than men. Suppose now that experience in sector 3 (time allocated to sector 3 activities) adds to the returns to schooling in that sector, but the other sectors' rates of return to schooling are not dependent upon the time spent. That is:

$$\alpha_{j3} = \alpha_3(t_{j3}),\ \alpha_3' > 0 \quad \text{for } j = m,f \tag{13}$$

Restriction (12) implies that males will allocate more time to the industry sector than equally schooled females. This is because, holding educational attainment constant, women spend less time in market activities than their male counterparts. This implies that men have a comparative advantage in working in market sectors where the returns to schooling increase with time spent, since they have more time to spend in market activities.

A simple example illustrates this. Suppose there are only two levels of education, high and low. Industry and services use only educated workers, while agriculture uses workers with low education levels. Experience is rewarded in industry and not in services (a simplification). Then educated workers with higher amounts of allocable market time, males in the present setup, will be employed in industry. Educated females will be sorted into the service sector, where the returns to schooling do not depend upon time spent working (i.e., the returns to work experience *per se* are zero).

Alternatively, we could assume some form of complementarity between the home and services sector. Suppose that time spent at home increases the productivity of a worker in the service sector but not in industry. Women will have an advantage in working in services since they spend more time at home than men. This advantage may be offset to the extent that sector-specific experience is important in the services sector, since women spend less time than men in nonhousehold activities. Yet another way to model this complementarity is to assume that it is easier to split time between home and services than between home and industry. This could be because it is easier for service workers to work at or close to home. A plausible cause is that industry generally requires greater installed physical capital than the service sector, which is relatively labor intensive. This results in women having a comparative advantage in services. (See Smith and Stelcner 1990).

Schultz (1989) reports the percentage of women in the labor force by sector. The relevant findings are reported in Table 1 below, both for sectoral employment and wage earners. These numbers support the assumption that a larger fraction of females is employed in services and commerce than in industry. This difference exists both in high income and in low income countries. So the assumption that women have a comparative advantage in the services sector seems to be robust for the entire spectrum of countries.[13]

The consequence of any of these assumptions is that an increase in the share of the industry sector will raise the demand for education of both males and females, but more for males. Conversely, an increase in the share of the services sector in total employment will increase the schooling demand of females by more than males. These implications of the theory can be tested.

(2) Health Investments, Rates of Return and Longevity

Incorporating effects of investment in health on the length of life can best be done by making total time available (T_m and T_f) a function of health levels:

$$T_m = T(H_m), \qquad T' > 0,\ T'' < 0 \tag{14a}$$

$$T_f = T(H_f), \qquad T' > 0,\ T'' < 0 \tag{14b}$$

[13]Schafgans (1990) finds similar patterns of female labor force participation in Peru during the mid-1980's.

Table 1

PERCENTAGE OF FEMALES IN THE LABOR FORCE, BY SECTOR BETWEEN 1950-1982

(For the Four Main Sectors of Employment)

Sector of Employment	Percentage of Females			
	In Labor Force		Among Wage Earners	
	High Income	Low Income	High Income	Low Income
Agriculture	32.7	28.4	18.9	31.5
Manufacture	29.8	25.8	29.7	20.7
Commerce	43.8	27.9	45.1	22.1
Services	52.0	31.8	53.5	31.8
Total	35.6	24.9	36.6	22.5

Source: Schultz (1989), Table 4.

Thus, investments in health increase the total amount of allocable time as well as (uniformly) increasing the returns in each sector. Both the level and the duration of returns are increased by investments in health. The interesting issue here is whether lifting the time constraint will affect the demand for human capital of males and females uniformly.

To address this issue, assume that: (a) women do not allocate any of the additional time to household activities, so the choices facing both men and women concern only the market sector, (b) industry rewards work experience more than the service sector, and (c) all factors of production (health, schooling and work experience) are subject to diminishing returns.

The effects of an increase in total time available T depend on the relative rates of return to work experience in each sector, and the curvature of sectoral production functions. To begin with, women allocate less time to market activities than men. Since experience is subject to diminishing returns in each sector, a one year increase in time available will raise the returns of women by more than men in each sector. In the market, health investments will therefore benefit women more than men. If industry rewards experience more than services, a larger fraction of the increase in time available will be allotted to industry. Thus, incorporating the effects of health on longevity results in: (a) larger increases in the market participation of women than men; and (b) larger increases in time allotted to industry than services for both sexes.[14]

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[14]Here the service sector should be thought of as all nonagricultural market activities in which experience is not a factor of production.

There is also an interaction between health and schooling. A larger T can be regarded as a longer payoff period to investments in human capital. Under reasonable conditions, this increase in the payoff period will increase the schooling levels of both men and women. Since returns to schooling are perceived to be greater in the market than in household tasks, and since market participation of women increases by more when life expectancy increases, the schooling levels of women will rise by more. From a policy evaluation perspective, some of the gains in gender equity that are attributed to education policy should in fact be credited to health extension services.

3. ESTIMATION RESULTS

Definitions of Variables

$S_{m,f}$ Investment in schooling of children is represented alternatively by primary and secondary school enrollment as a percentage of the population in the age group that should be enrolled in primary school (aged 6 to 11 years) and secondary school (aged 12 to 17 years) respectively. For example, if male primary school enrollment in a country is 50,000, and the total number of boys aged 6 to 11 years is 100,000, then S_m equals 50 percent. Notice that this percentage could be greater than 100 if a significant fraction of the population older than 11 years is enrolled in primary school. Therefore, high primary school enrollment ratios are not necessarily a good thing. The problem is less severe for secondary school, but it may nonetheless exist.

To overcome this problem, we report results using ratios of female to male schooling as a dependent variable (S_f/S_m). Since the denominators in schooling enrollment ratios (the number of girls and boys in the age groups 6-11 and 12-17 years) are likely to be very similar in magnitude across sexes, female-male schooling ratios are likely to be more reliable than S_f and S_m singly.

$H_{m,f}$ Health investments are proxied by life expectancy at birth in years. The problems with treating life expectancy as a measure of investment in health include: (a) Life expectancy at birth often depends on a different set of factors than life expectancy at older ages, due to infant mortality. (b) Gender differences in life expectancy depend significantly on biological factors. (c) Variation in life expectancy rates across countries is very small compared to international differences in health levels as measured by morbidity, anthropometric indices, nutritional intake, and so on. (d) Life expectancy levels will at best capture investments in health aimed at increasing the "quantity of life" and not "quality of life".

For these reasons, health regressions must be interpreted differently and more narrowly than schooling regressions.

Y Per capita income is used to represent household income. For cross-section estimations for the years 1965 and 1987, these data were from World Bank (1990). For the pooled cross-section time-series estimations, per capita income data were from Summers and Heston (1988), for the years 1965 and 1985. This was done because pooled estimations require per capita figures in constant prices, and Summers and Heston report deflated per capita income (using three types of deflators) that are generally considered superior to price data in World Bank (1990).

t_i The time allotted to agriculture, industry, and services (t_1, t_2, and t_3 respectively) are proxied by their shares in total employment. The data for employment shares are from United Nations (1990).[15]

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[15] We also experimented with sectoral shares in national income, using data for GDP shares from World Bank (1990). Technically, since t_i is interpreted as the probability of being employed in sector i, the share of each sector in total *employment* is the appropriate measure of t_i. One rationale for using shares in total *income* (GDP) is that this measure reflects both the probability and *returns from employment* in each sector. However, GDP share data are less reliable. Only the results of regressions using employment

P_S, P_H The prices of schooling and health are proxied by the degree of urbanization: the percentage of population living in urban areas. The degree of urbanization is expected to be negatively correlated with both P_S and P_H. Schooling and health services are generally more easily accessible and of better quality in urban areas. Therefore, the larger the fraction of population living in rural areas, the higher are the average costs of obtaining educational or health services.[16]

Since P_S and P_H are not available separately, the effects of changes in the relative price of schooling (health) on health (schooling) investments cannot be measured. As a result, the differences in price elasticities of these components of human capital cannot be studied.[17]

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shares are reported in this paper.

[16]The price of schooling may be higher in rural areas for another reason. Rural areas are generally agricultural. If children are employed in greater numbers in agriculture (than in industry or services) because of the nature of tasks, the total price of schooling may be higher in rural areas due to the higher opportunity costs faced by children of schoolgoing age.

[17]Another difference between the prices of health and schooling arises because schooling requires time input of children while investments in health do not. We do not address this issue.

Discussion of Regression Results

The equations for schooling to be estimated are:

$$S_f = \phi_0 + \phi_1\text{Per Capita GDP} + \phi_2\text{Industry Share} + \phi_3\text{Services Share} + \phi_4\text{Urbanization} + \epsilon_{sf} \qquad (15a)$$

$$S_m = \mu_0 + \mu_1\text{Per Capita GDP} + \mu_2\text{Industry Share} + \mu_3\text{Services Share} + \mu_4\text{Urbanization} + \epsilon_{sm} \qquad (15b)$$

$$S_f/S_m = \rho_0 + \rho_1\text{Per Capita GDP} + \rho_2\text{Industry Share} + \rho_3\text{Services Share} + \rho_4\text{Urbanization} + \epsilon_s \qquad (15c)$$

The equations for health are:

$$H_f = \sigma_0 + \sigma_1\text{Per Capita GDP} + \sigma_2\text{Industry Share} + \sigma_3\text{Services Share} + \sigma_4\text{Urbanization} + \epsilon_{hf} \qquad (16a)$$

$$H_m = \tau_0 + \tau_1\text{Per Capita GDP} + \tau_2\text{Industry Share} + \tau_3\text{Services Share} + \tau_4\text{Urbanization} + \epsilon_{hm} \qquad (16b)$$

$$H_f/H_m = \upsilon_0 + \upsilon_1\text{Per Capita GDP} + \upsilon_2\text{Industry Share} + \upsilon_3\text{Services Share} + \upsilon_4\text{Urbanization} + \epsilon_h \qquad (16c)$$

To examine the correspondence between estimated schooling equations (15a) and (15b) and the schooling demand functions (9a) and (9b) respectively, rewrite any of the latter in its logarithmic form, e.g.,

$$\text{Log}(S) = \text{Log}(K) + \text{Log}(\beta\Sigma\alpha_i t_i) - \text{Log}(\delta P_s) \qquad (17)$$

It can then be seen that, in the general forms estimated below, coefficients for sector shares (t_i) capsule the magnitudes β and α_i. Relative values of these coefficients therefore depend only on α_i, the sectoral coefficients of schooling in the human capital earnings functions.

Similarly, in the correspondence between estimated health equations

(16a) and (16b) and the demand functions (9c) and (9d) respectively, the coefficients for sector shares (t_i) capsule the magnitudes β and a_i. Relative values of coefficients for t_i therefore depend only on a_i, the sectoral coefficients of health in the human capital earnings functions. Since we have assumed that $a_i = a$, for all i, the differences in these coefficients reflect only second-order effects (which are supressed by the assumption of a Cobb-Douglas functional form for the human capital earnings functions, but which are allowed for in the general formulation of the estimated demand functions). Differences in these coefficients could also reflect the impact of health investments on the time available (T), due to the longevity-increasing effects of these investments. This is discussed further in subsection (4) below.

The two education intensive sectors (industry and services) are included in the regression, and the low education sector (agriculture) is excluded. If industry sector increases in importance relative to agriculture, *holding the share of services constant*, schooling demand increases. Similarly, if the share of services in employment rises at the expense of agriculture, *with no change in the share of the industrial sector*, then the demand for education will unambiguously increase. However, if industry's share declines at the same time that the share of services rises, the effect on aggregate schooling demand is ambiguous. Hence agriculture must be the omitted class.

Table 2 reports summary statistics for a sample of 91 countries in 1965, and 87 countries in 1987. Table 3 lists correlations between the main variables used in the above regressions. Table 4 provides results for equations using primary school enrollment ratios as the dependent variable,

Table 5 for those using secondary school enrollment, and Table 6 reports life expectancy regressions. Samples consist of all countries for which the data were reported. Table 7 and 8 report results for fixed-effects regressions for secondary school enrollment and life expectancy respectively.

From the matrix in Table 3, we can see that the raw correlation between industry share and enrollment is higher for males than for females. The raw correlation betweeen services share and enrollment, on the other hand, is higher for females than for males. The correlations for health (last two columns) are remarkably gender neutral. The share of services in total labor force is, however, highly collinear with time (0.82), and the degree of urbanization (0.72), while the share of industry is not. Including time and the degree of urbanization will undoubtedly weaken the observed relationship between services share, school enrollment and life expectancy.

Diagnostic checks for the regressions confirmed the existence of multicollinearity problems with regressions that include urbanization. Condition indices are greater than 100 (See Belsley, Kuh and Welsh 1980). When urbanization is not included, the problem of multicollinearity disappears; the condition indices drop to below 30. Since urbanization (representing P_S or P_B) is an important variable, and must be included in regressions, we report both regressions with and without the degree of urbanization.

(1) Primary School Enrollment Regressions: 1965 and 1987

The results for regressions that use primary school enrollment ratios as measures of investment in schooling of girls and boys provide some support for the theory. (See Table 4 below, especially the coefficients in bold letters). While primary school enrollment numbers are relatively poor indicators of investments in education (see section on Definitions of Variables above), female-to-male ratios are better indicators of gender differences in these investments. The results of these equations for 1965 indicate that while increases in services share reduces the gender gap in primary school enrollment, the effect of industry share is insignificant. In 1987, however, both sectors become beneficial to gender equity, possibly reflecting a worldwide decrease in market segmentation during these 23 years. Given the degree of multicollinearity between the independent variables, high t-statistics for are especially reassuring.

(2) Secondary School Enrollment Regressions: 1965 and 1987

The results of secondary school regressions (Table 5) below are identical in spirit to the primary school regressions. There are again structural differences in the equations for the two years, with industry becoming the more important equalizer of schooling investments of boys and girls in 1987. Per capita income also becomes an important influence in 1987, which is somewhat puzzling, since one would expect budget constraints to be more binding in 1965. But due to high multicollinearity, the estimated coefficients for per capita income and degree of urbanization are unreliable.

(3) Life Expectancy (Health) Regressions: 1965 and 1987

Health regressions must be interpreted differently from schooling regressions, since effects of investments in health increase both the returns to human capital within a period and the duration of these returns. Life expectancy at birth is assumed to represent the probability of surviving a given period, which depends in turn on the amount of health investment. Regressions using female-to-male ratios of life expectancy yield very poor fits (unadjusted coefficients of determination are less than 0.15), so only the female and male life expectancy regressions are discussed here.

The results are remarkably gender-neutral for both 1965 and 1987. In 1987 even the intersectoral differences (between services and industry) become statistically insignificant, although coefficients for females are usually somewhat larger. This is consistent with a decrease over time in segmentation of the market for human capital.[18]

(4) Fixed-Effects Regressions (1965-1987)

To weed out country effects that may be present in yearly cross-section data, we adopt the following procedure: The mean of each variable for 1965 and 1987 was calculated for each country. Regressions employed deviations

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[18]Regressions using shares of industry and services in total GDP as instruments for the structure of production are similar to results using employment shares. The main difference is that the coefficient for per capita income in these regressions is always positive and significant.

We also estimated regressions using both GDP and employment shares. These are not reported here for the sake of brevity. Employment shares pick up more of the variation in human capital than do GDP shares, though this is more the case for services than for industry. A likely explanation is that parents can observe the difference between probability of employment in services and agriculture (the omitted sector), but not the expected income in the services sector, since it generally consists of informal services. On the other hand, formal sector (industry) income possibilities are easier to observe. Hence, we should observe the GDP share for industry and employment share for services to pick up the effects of production structure on demand for human capital. The results provide some evidence consistent with these conjectures.

from the mean.[19] Tables 7 and 8 list the results for schooling -- only secondary school regressions are reported for the sake of brevity -- and health regressions using pooled data for 1965 and 1987 (1985 for per capita income). The sample size was smaller (72) since it consists of countries that have the required data for both 1965 and 1987.

Secondary school enrollment regressions provide strong support for the predictions of the theory. The services sector's share has a larger

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[19]For details, see Binswanger, Khandker and Rosenzweig (1989). Let D_{jt} be the set of variables that proxy the production structure in country j at time t (sectoral shares of industry and services in employment/GDP), and

$$D_{jt} = D_{jt}(U_j, \epsilon_{jt}) \tag{20}$$

where U_j is the effect of unmeasured country factors, and ϵ_{jt} is a time-specific error term. Let C_{ijt} be the level of the ith human capital variable in country j at time t. Then

$$C_{jt} = C_{jt}(D_{jt}, Y_{jt}, P_{jt}, U_j, \epsilon_{jt}). \tag{21}$$

where Y_{jt} and P_{jt} are per capita income and degree of urbanization in country j at time t The simultaneity between C_{jt} and D_{jt} arising from their joint dependence on unobserved country-level variables U_j can be overcome if an additive model is estimated

$$C_{jt} = c_0 + c_1Y_{jt} + c_2D_{jt} + c_3P_{jt} + c_4U_j + \epsilon_{jt} \tag{22}$$

The relationship for country means over time is

$$\bar{C}_{j.} = c_0 + c_1\bar{Y}_{j.} + c_2\bar{D}_{j.} + c_3\bar{P}_{j.} + c_4U_j + \bar{\epsilon}_{j.} \tag{23}$$

Subtracting equation (23) from (22) we get

$$(C_{jt} - \bar{C}_{j.}) = c_1(Y_{jt} - \bar{Y}_{j.}) + c_2(D_{jt} - \bar{D}_{j.}) + c_3(P_{jt} - \bar{P}_{j.}) + (\epsilon_{jt} - \bar{\epsilon}_{j.}) \tag{24}$$

If ϵ_{jt} is random and uncorrelated with D_{jt}, then this relationship can be estimated using ordinary least squares.

positive effect on female secondary schooling than does the share of industry in employment. Industry share in fact has a significant unfavorable effect on investments in female schooling, and an insignificant effect for males. Per capita income has a higher coefficient for female school enrollment, though the coefficient is statistically significant only at the 10 percent level. Urbanization exerts a positive gender-neutral influence for both boys and girls. The time trend is statistically significant, and the regressions that use female-to-male enrollment ratio as the dependent variable indicate some equalization over time.

Health regressions display relatively gender neutral results. Industry share is more important than that of services in determining health investments. The result is not surprising when the longevity enhancing effects of health investments are considered. (See discussion in section 2). Since industry is the sector where experience is valued more than in other sectors, increases in life expectancy (available time T) will increase the time devoted by both men and, to a greater extent, women to industry at the expense of services. So while increases in both industry and services increase the investments in health, the longevity enhancing effects of these investments are more important than the (within period) productivity of health as an argument in human capital earnings functions.

The time trend in life expectancy dwarfs other influences, implying important omitted variables. Urbanization exerts a positive, gender-neutral influence on life expectancy. Regressions using female-male life expectancy ratios yield poor fits: Coefficients of determination are smaller than 0.06.

Table 2

MEAN & STANDARD DEVIATIONS OF VARIABLES, 1965 AND 1987

Variable	1965		1987	
	Mean	S.D.	Mean	S.D.
RHS Variables:				
Per Capita GDP (Current Prices)	547.15	760.22	4291.63	5860.05
Per Capita GDP (Constant Prices)	2526.00	4968.00	3428.00	3780.00
Share of Industry in GDP	27.63	13.18	29.73	10.79
Share of Services in GDP	44.22	10.46	49.49	10.66
Share of Agriculture in GDP	28.18	18.48	20.81	16.94
Share of Industry in Employment	18.00	13.80	14.30	8.20
Share of Services in Employment	26.00	16.00	43.20	23.60
Share of Agriculture in Employment	55.70	29.30	42.40	29.30
Degree of Urbanization	36.28	24.59	48.99	25.60
LHS Variables:				
Female Primary School Enrollment	68.36	35.24	86.00	30.66
Male Primary School Enrollment	84.87	29.80	95.68	24.43
Female/Male Primary School Ratio	0.76	0.26	0.88	0.18
Female Secondary School Enrollment	19.76	21.71	46.68	34.02
Male Secondary School Enrollment	26.10	22.19	50.47	29.67
Female/Male Secondary School Ratio	0.60	0.32	0.83	0.33
Female Life Expectancy at Birth	55.16	11.97	64.94	11.35
Male Life Expectancy at Birth	51.82	10.81	60.66	9.99
Female/Male Life Expectancy Ratio	1.06	0.03	1.07	0.03

Notes: Enrollment percentages are ratios of enrollment in school to the population in the relevant age group.

Table 3

CORRELATIONS BETWEEN VARIABLES, 1965 AND 1987

	Y	t_2	t_3	P	S_f^{PRI}	S_m^{PRI}	S_f^{SEC}	S_m^{SEC}	H_f	H_m
Time	.24	-.34	.82	.84	.68	.51	.85	.87	.94	.93
Per Capita Income (Y)		-.15	.27	.11	.09	.13	.28	.26	.13	.14
LF Share of Industry (t_2)			-.49	-.19	.07	.16	-.46	-.37	-.18	-.17
LF Share of Services (t_3)				.72	.49	.37	.85	.81	.76	.75
Urbanization (P)					.68	.52	.75	.79	.85	.85
Female Primary School Enrollment (S_f^{PRI})						.87	.48	.60	.78	.80
Male Primary School Enrollment (S_m^{PRI})							.32	.43	.59	.62
Female Secondary School Enrollment (S_f^{SEC})								.95	.80	.78
Male Secondary School Enrollment (S_m^{SEC})									.85	.84
Female Life Expectancy (H_f)										.99
Male Life Expectancy (H_m)										

Table 4

CROSS-SECTION PRIMARY SCHOOLING REGRESSIONS, 1965 AND 1987

Dependent Variable	Independent Variables*					
	PER CAP. GDP	SHARE IN EMPLOYMNT INDUSTRY	SHARE IN EMPLOYMNT SERVICES	DEGREE URBAN	UNADJ. R-SQR.	SAMPLE SIZE
1965						
Female Primary Enrollment	-0.0007 (-0.90)	0.9498 (2.14)	0.9810 (2.37)		.534	91
Male Primary Enrollment	-0.0002 (-0.22)	0.6477 (1.52)	0.7225 (1.82)		.404	91
Female/Male Primary Ratio	-0.0000 (-1.35)	0.0049 (1.26)	0.0073 (2.02)		.356	91
Female Primary Enrollment	-0.0007 (-0.93)	1.0574 (2.12)	1.1360 (2.18)	-0.1583 (-0.49)	.536	91
Male Primary Enrollment	0.0002 (0.23)	0.6772 (1.41)	0.7650 (1.52)	-0.0434 (-0.14)	.405	91
Female/Male Primary Ratio	-0.0000 (-1.40)	0.0063 (1.45)	0.0094 (2.05)	-0.0021 (-0.73)	.362	91
1987						
Female Primary Enrollment	-0.0015 (-1.21)	1.0020 (2.24)	0.7516 (3.32)		.409	87
Male Primary Enrollment	-0.0016 (-1.42)	0.4338 (1.09)	0.5827 (2.88)		.245	87
Female/Male Primary Ratio	-0.0000 (-0.39)	0.0074 (2.93)	0.0034 (2.63)		.443	87
Female Primary Enrollment	-0.0019 (-1.32)	0.9323 (1.99)	0.6996 (2.84)	0.1294 (0.55)	.411	87
Male Primary Enrollment	-0.0022 (-1.77)	0.3087 (0.75)	0.4894 (2.23)	0.2319 (1.11)	.259	87
Female/Male Primary Ratio	-0.0000 (-0.09)	0.0079 (2.96)	0.0037 (2.64)	-0.0008 (-0.58)	.445	87

* *Intercept term not reported; t-statistics in parentheses. Employment Shares are percentages.*

Table 5

CROSS-SECTION SECONDARY SCHOOLING REGRESSIONS, 1965 AND 1987

Dependent Variable	Independent Variables*					
	PER CAP. GDP	SHARE IN EMPLOYMNT INDUSTRY	SHARE IN EMPLOYMNT SERVICES	DEGREE URBAN	UNADJ. R-SQR.	SAMPLE SIZE
		1965				
Female Secondary Enrollment	-0.0001 (-0.23)	0.8939 (4.35)	0.5109 (2.67)		.750	91
Male Secondary Enrollment	0.0001 (0.30)	0.9142 (4.17)	0.4768 (2.34)		.730	91
Female/Male Secondary Ratio	-0.0000 (-1.83)	0.0041 (1.03)	0.0138 (3.67)		.544	91
Female Secondary Enrollment	-0.0001 (-0.32)	1.0138 (4.44)	0.6835 (2.85)	-0.1763 (-1.19)	.755	91
Male Secondary Enrollment	0.0001 (0.24)	1.0033 (4.10)	0.6052 (2.36)	-0.1312 (-0.83)	.732	91
Female/Male Secondary Ratio	-0.0000 (-1.95)	0.0069 (1.54)	0.0177 (3.78)	-0.0040 (-1.39)	.557	91
		1987				
Female Secondary Enrollment	0.0035 (4.67)	0.7463 (2.81)	0.5940 (4.42)		.821	87
Male Secondary Enrollment	0.0030 (3.90)	0.3780 (1.40)	0.5524 (4.04)		.757	87
Female/Male Secondary Ratio	-0.0000 (-0.63)	0.0156 (3.50)	0.0059 (2.63)		.468	87
Female Secondary Enrollment	0.0034 (3.95)	0.7111 (2.56)	0.5678 (3.87)	0.0652 (0.47)	.822	87
Male Secondary Enrollment	0.0028 (3.29)	0.3473 (1.23)	0.5294 (3.55)	0.0569 (0.40)	.757	87
Female/Male Secondary Ratio	-0.0000 (-0.64)	0.0154 (3.29)	0.0057 (2.34)	0.0005 (0.19)	.468	87

* *Intercept term not reported; t-statistics in parentheses. Employment Shares are percentages.*

Table 6

CROSS-SECTION HEALTH (LIFE EXPECTANCY) REGRESSIONS, 1965 AND 1987

Dependent Variable	Independent Variables*					
	PER CAP. GDP	SHARE IN EMPLOYMNT INDUSTRY	SHARE IN EMPLOYMNT SERVICES	DEGREE URBAN	UNADJ. R-SQR.	SAMPLE SIZE
			1965			
Female Life Expectancy	-0.0002 (-1.63)	0.5685 (6.48)	0.2849 (3.49)		.848	91
Male Life Expectancy	-0.0002 (-1.44)	0.4698 (5.55)	0.2878 (3.66)		.828	91
Female/Male Life Expectancy Ratio	-0.0000 (-0.39)	0.0010 (1.79)	-0.0003 (-0.52)		.089	91
Female Life Expectancy	-0.0002 (-1.72)	0.6159 (6.30)	0.3532 (3.45)	-0.0698 (-1.10)	.851	91
Male Life Expectancy	-0.0002 (-1.57)	0.5332 (5.71)	0.3792 (3.87)	-0.0933 (-1.54)	.834	91
Female/Male Life Expectancy Ratio	-0.0000 (-0.29)	0.0006 (1.02)	-0.0008 (-1.23)	-0.0006 (-1.35)	.113	91
			1987			
Female Life Expectancy	0.0009 (3.58)	0.3678 (3.58)	0.2209 (5.16)		.839	87
Male Life Expectancy	0.0007 (3.11)	0.2823 (3.60)	0.2151 (5.42)		.824	87
Female/Male Life Expectancy Ratio	0.0000 (1.12)	0.0010 (2.00)	-0.0001 (-0.51)		.126	87
Female Life Expectancy Ratio	0.0008 (2.82)	0.3474 (3.94)	0.2056 (4.42)	0.0379 (0.85)	.840	87
Male Life Expectancy Ratio	0.0006 (2.56)	0.2719 (3.31)	0.2073 (4.79)	0.0193 (0.46)	.825	87
Female/Male Life Expectancy Ratio	0.0000 (0.44)	0.0009 (1.59)	-0.0003 (-0.96)	0.0003 (1.28)	.147	87

* *Intercept term not reported; t-statistics in parentheses. Employment Shares are percentages.*

Table 7

FIXED EFFECTS SCHOOLING (SECONDARY SCHOOL ENROLLMENT) REGRESSIONS, 1965-87
(Sample consists of 72 countries: LDCs, Middle Income & Industrialized)

Dependent Variable	Independent Variables					
	TIME DUMMY	PER CAP. GDP	SHARE IN EMPLOYMNT INDUSTRY	SHARE IN EMPLOYMNT SERVICES	DEGREE URBAN	ADJ. R-SQR.
Female Secondary Enrollment	14.3753 (7.04)	0.0004 (1.27)	-0.2694 (-2.14)	0.5371 (5.11)		.787
Male Secondary Enrollment	16.5344 (9.02)	0.0002 (0.77)	-0.0544 (-0.48)	0.3469 (3.68)		.784
Female/Male Secondary Ratio	0.2062 (7.72)	-4.2e-6 (-1.05)	0.0069 (4.21)	0.0027 (1.95)		.627
Female Secondary Enrollment	11.1035 (4.31)	0.0005 (1.62)	-0.3337 (-2.59)	0.4910 (4.61)	0.2826 (2.04)	.792
Male Secondary Enrollment	12.6151 (5.52)	0.0003 (1.25)	-0.1315 (-1.15)	0.2916 (3.09)	0.3385 (2.76)	.794
Female/Male Secondary Ratio	0.1462 (4.40)	-2.3e-6 (-0.57)	0.0058 (3.48)	0.0018 (1.33)	0.0052 (2.90)	.646

Notes: t-statistics in parentheses.

Table 8

FIXED EFFECTS HEALTH (LIFE EXPECTANCY) REGRESSIONS, 1965-87
(Sample consists of 72 countries: LDCs, Middle Income & Industrialized)

Dependent Variable	Independent Variables					
	TIME DUMMY	PER CAP. GDP	SHARE IN EMPLOYMNT INDUSTRY	SHARE IN EMPLOYMNT SERVICES	DEGREE URBAN	ADJ. R-SQR.
Female Life Expectancy	9.5670 (20.27)	-0.0002 (-3.50)	0.1683 (5.78)	0.0480 (1.98)		.905
Male Life Expectancy	8.5593 (18.06)	-0.0002 (-2.61)	0.1523 (5.21)	0.0404 (1.66)		.883
Female/Male Expectancy Ratio	0.0087 (2.34)	-2.9e-7 (-0.51)	0.0001 (0.44)	-0.0000 (-0.22)		.060
Female Life Expectancy	8.4088 (14.41)	-0.0002 (-3.01)	0.1455 (5.00)	0.0316 (1.31)	0.1000 (3.19)	.911
Male Life Expectancy	7.4572 (12.68)	-0.0002 (-2.13)	0.1307 (4.46)	0.0248 (1.02)	0.0951 (3.02)	.889
Female/Male Expectancy Ratio	0.1113 (2.36)	-3.7e-7 (-0.65)	0.0002 (0.63)	-7.3e-6 (-0.04)	-0.0002 (-0.86)	.058

Notes: t-statistics in parentheses.

4. POLICY IMPLICATIONS AND CONCLUSIONS

For the purposes of policy making, the main weakness of this paper is that it does not forcefully address the issue of causality between the structure of production (shares of agriculture, industry, and services) and education. That is, the empirical analysis cannot determine whether changes in the structure of the economy cause increases in the demand for education, or whether increases in education levels facilitate a largely exogenous transition from an agrarian to an industrial/service economy. To determine policy, strong correlations between education and production structure are not enough; we need to know the direction of causality.

This paper tries to finesse this problem by using enrollment rates in primary and secondary school, and not education levels of adults. In the case of health investments, similarly, we use life expectancy at birth and not health stocks of working adults. Gill (1990) also addresses this issue of causality by estimating the demand for education in Peru during the 1980s by age group. The schooling of children (younger groups) is strongly correlated with structure of production, but this correlation is found to be weak for older workers. It is therefore likely that the causality runs from production structure to schooling demand, and not the other way round.

If this issue of causality is resolved in favor of the views expressed in this paper, some interesting policy implications emerge. The main implication is that service sector expansion helps to reduce gender inequity at the same time as fostering growth. This runs counter to the policy advocated by the World Bank and the International Monetary Fund that developing countries encourage production of tradable goods (produced mainly in agriculture, and to a smaller extent, in industry) to service debt. For the purposes of promoting gender equity, the production of nontradables (service sector products) should be strongly encouraged.

This finding also highlights the problem with relying purely on economic growth to reduce the gender gap in human capital. Theories of economic growth proposed by Rostow (1960) and Rosenstein-Rodan (1961) imply that income growth is accompanied by structural transformation of an economy from agrarian to industrial and then to one dominated by the services sector. There is no assurance that during the early stages of this transformation, the economic status of women will improve.[20] If the human capital of women has significant externalities (that is, if social returns to women's education and health are higher than private returns), this strengthens the case for direct government intervention in the process of investment in women's human capital.

[20]Though endogenous fertility, as mentioned in an earlier footnote, could change this result.

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